TPC Gain Calibration Update

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Task List

1. TPC Gain Corrections
    a. Anode voltage variation
    b. Drift attenuation

Almost Done…

2. Truncation parameter optimization
3. Compare effect of fitted/unfitted hits on <dE/dx>
4. Resolution vs Nhits analysis/parameterization
5. Bethe-Bloch parameter extraction
6. PID likelihoods using (4) and (5) given track <dE/dx>, momentum, Nhits

TPCRAnodeCalib

- Selects beam tracks: one track in event, travels straight down the middle of the TPC ($|x-x_{target}|<10$cm && $|y-y_{target}|<10$cm)
- Histograms Cluster dE/dx for different anode regions (every 8 padrows)
- At end of run, fits Landau function to dE/dx distributions and writes histograms to file
- If WriteToDB == true, stores Landau MPV, error and fit status flag to calib database.

Code is checked in to TPCRecoJP, ready to be run in pass2.

Documentation in progress has been checked in to TPCNotes

Beam track pileup

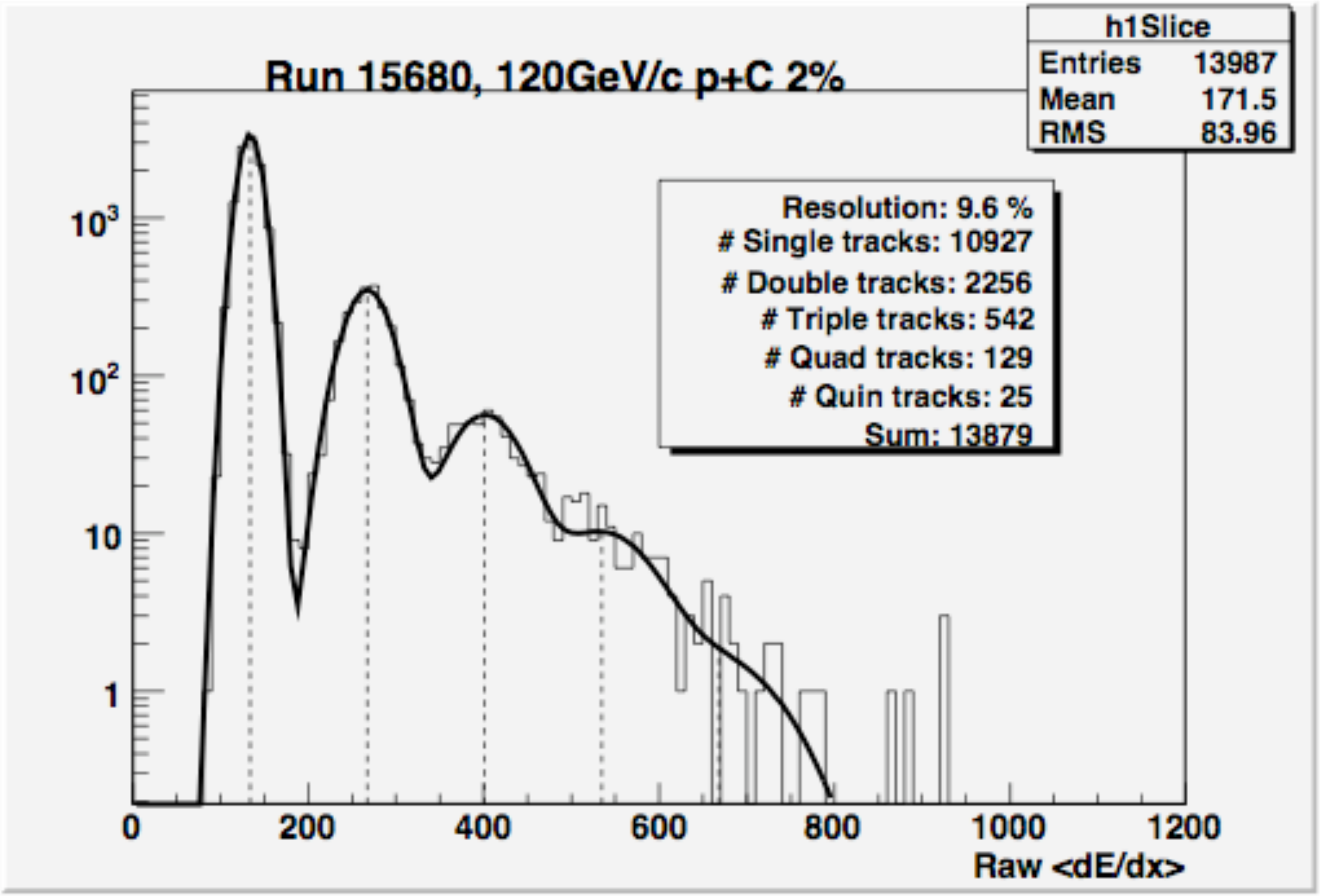

Figure 5: $\langle dE/dx \rangle$ for tracks constrained within a 10cm x 10cm box around the target from single-track events. The free parameters in the five Gaussian fit are the five amplitudes and the mean and sigma of the lowest Gaussian. All others are constrained to integer multiples of the lowest one.

Beam track Nhits

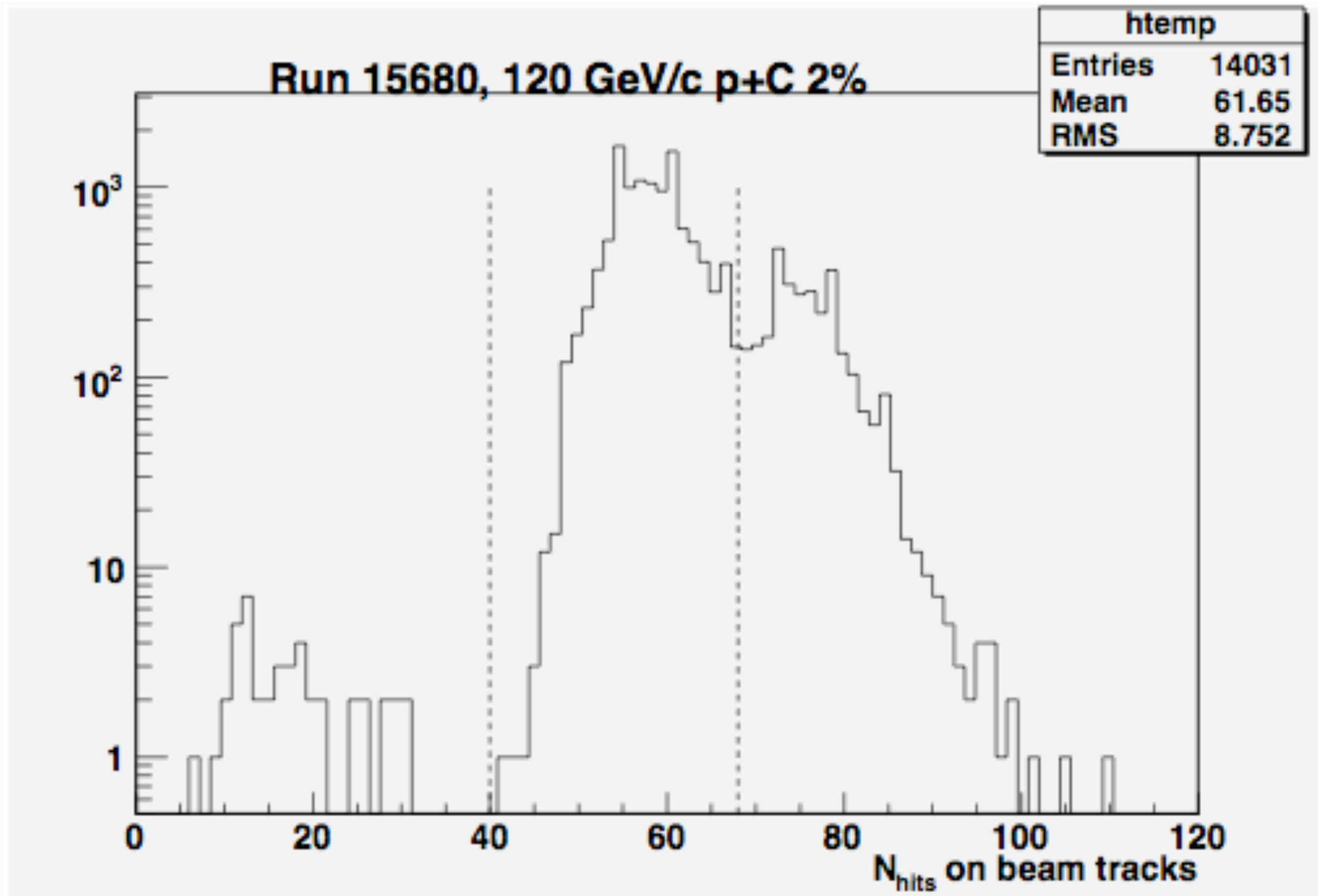

Figure 6: N_{hits} for beam tracks

Beam tracks with Nhits cuts

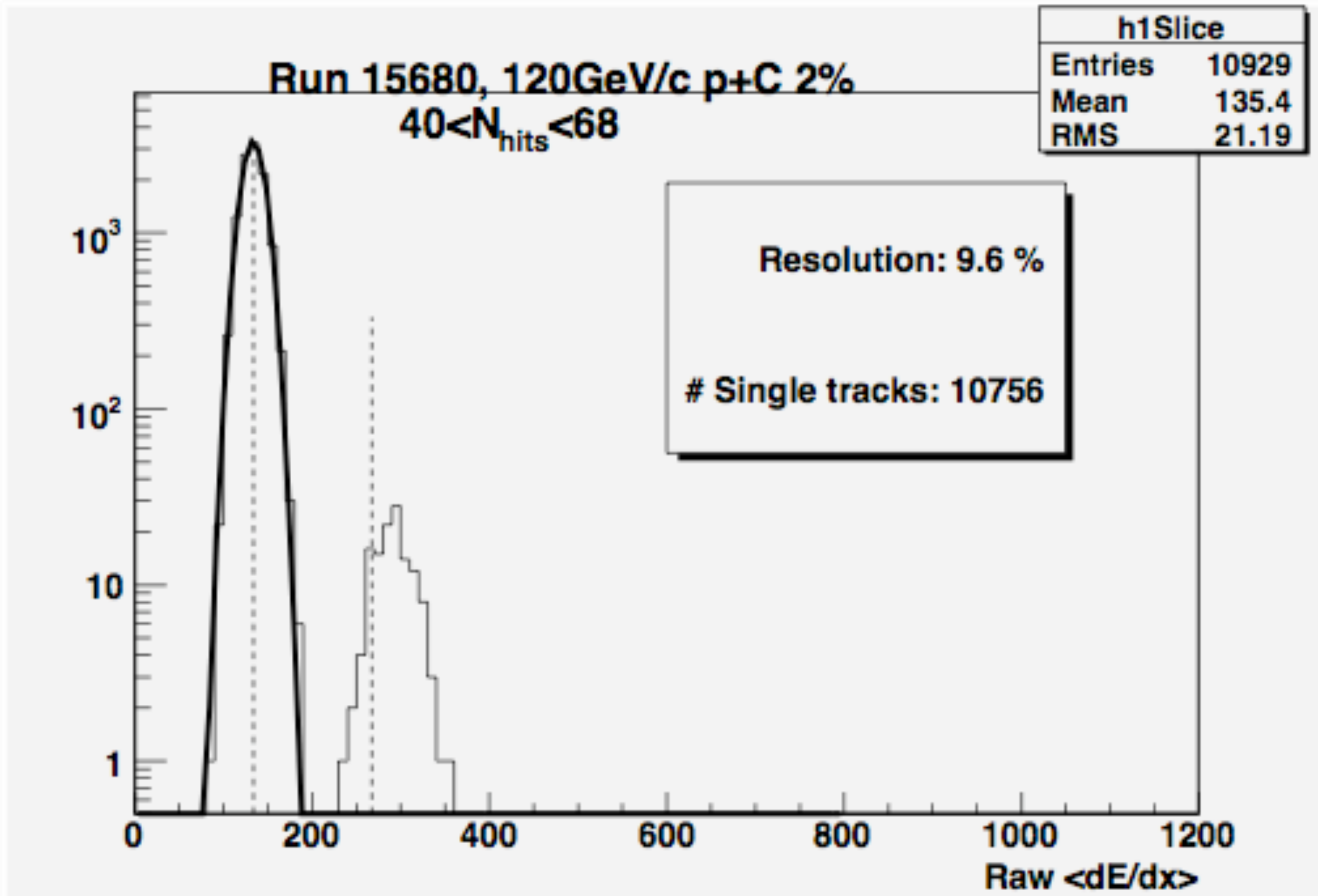

Figure 7: $\langle dE/dx \rangle$ for beam tracks with the additional cut on $N_{hits} < 68$. Pileup tracks are now only 1% of the total.

Landau Fits

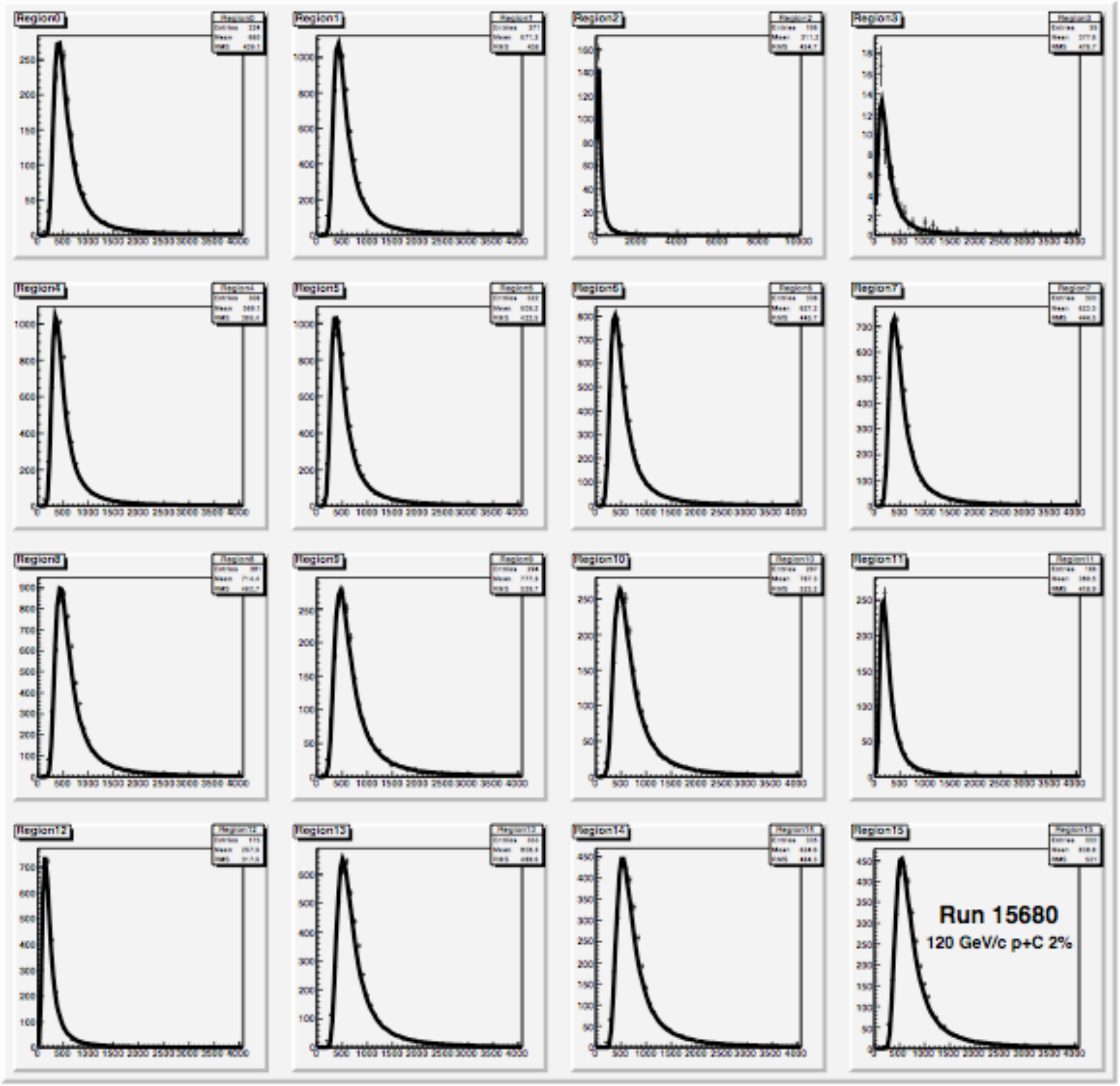

Figure 8: Landau fits to dE/dx from beam tracks for each anode region.

Landau MPV by anode

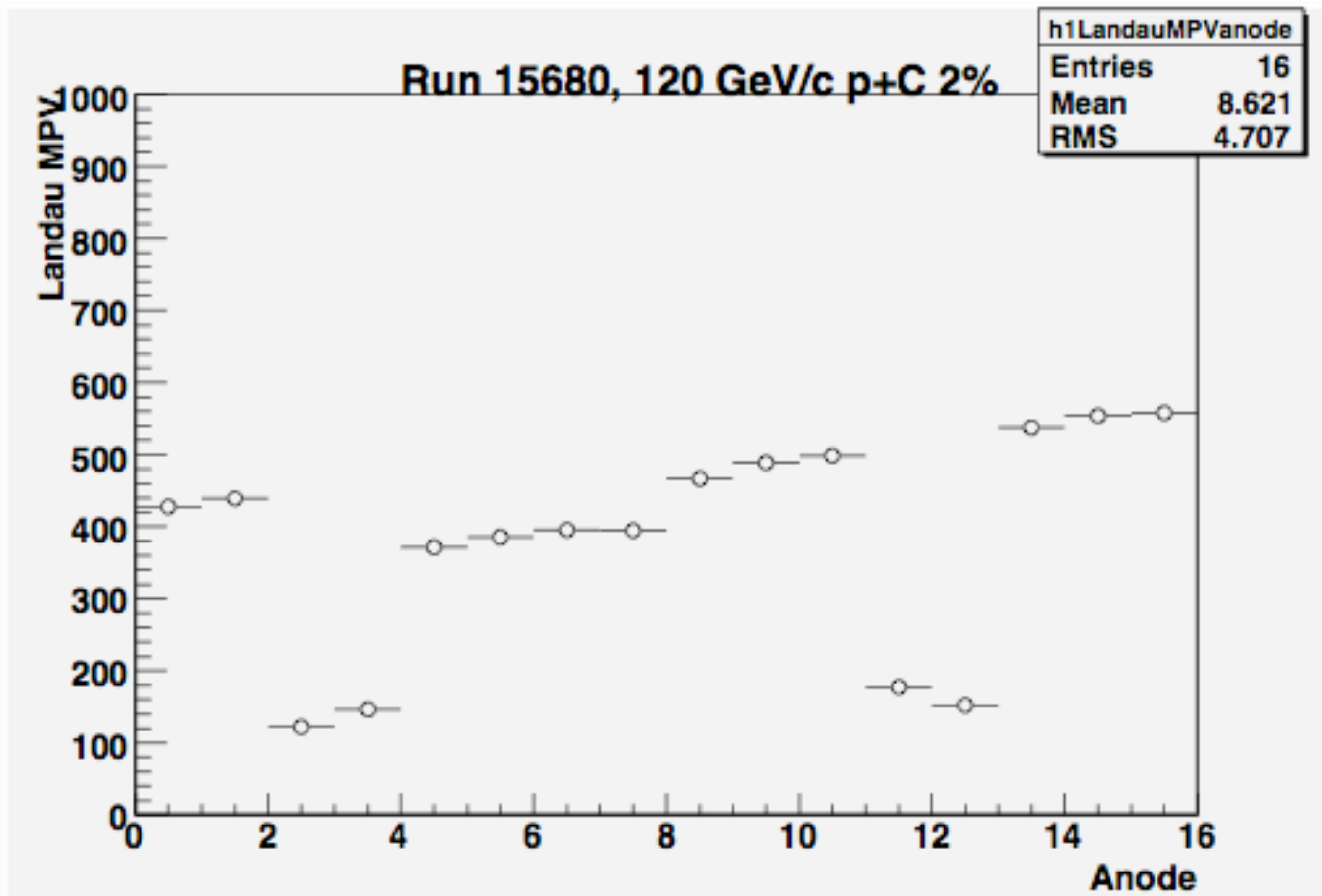

Figure 9: Most probable value (MPV) from Landau fits to dE/dx from beam tracks for each anode region.

Run variation of MPV

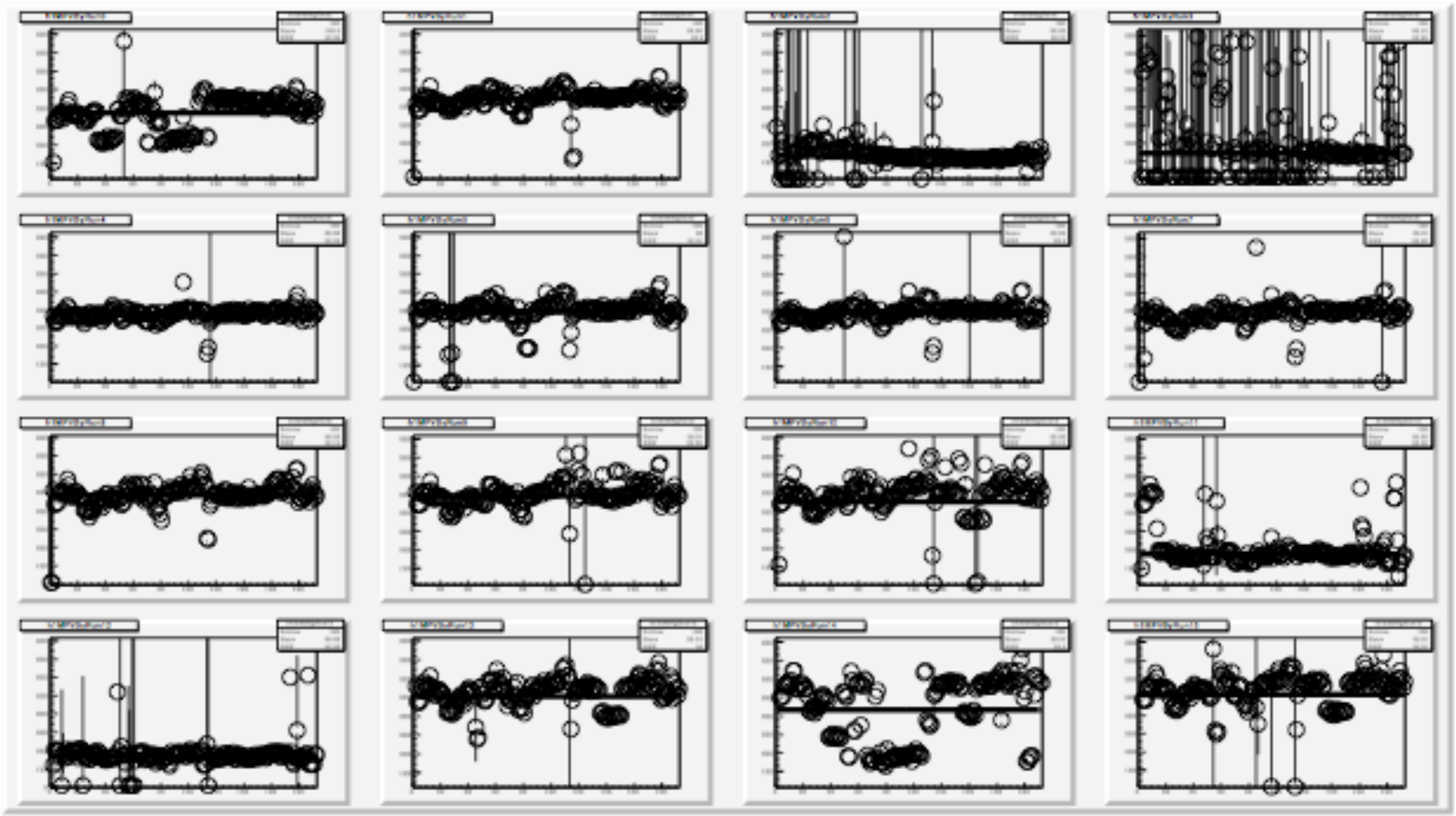

Figure 10: Most probable value (MPV) from Landau fits to dE/dx from beam tracks for each anode region as a function of run number for every tenth run.

TPCRDriftCalib

- Must be run after TPCRAnodeCalib, because it requires anode calibrated values
- Reads anode calibrations from DB for the given run
- Selects tracks which have Nhits > 20, start position within ($|x-x_{target}|<10$cm && $|y-y_{target}|<10$cm) and atan(dy/dz) > 0.2 (== ~11°)
- Applies anode calibration to each cluster dE, then histograms the dE/dx in separate regions of average cluster timebucket (160 buckets/4 == 40 histograms, but only middle ~20 histograms are useful)
- At end of run, fits Landau function to dE/dx distributions and creates a new histogram with Landau MPV vs. timebucket bin
- Fits MPV vs. bucketbin with an exponential to extract drift attenuation coefficient, writes histograms to file
- If WriteToDB == true, stores attenuation coefficient, error and fit status flag to calib database.

Code is checked in to TPCRecoJP, ready to be run in pass2.

Documentation in progress has been checked in to TPCNotes

MPV vs. Timebucket/4

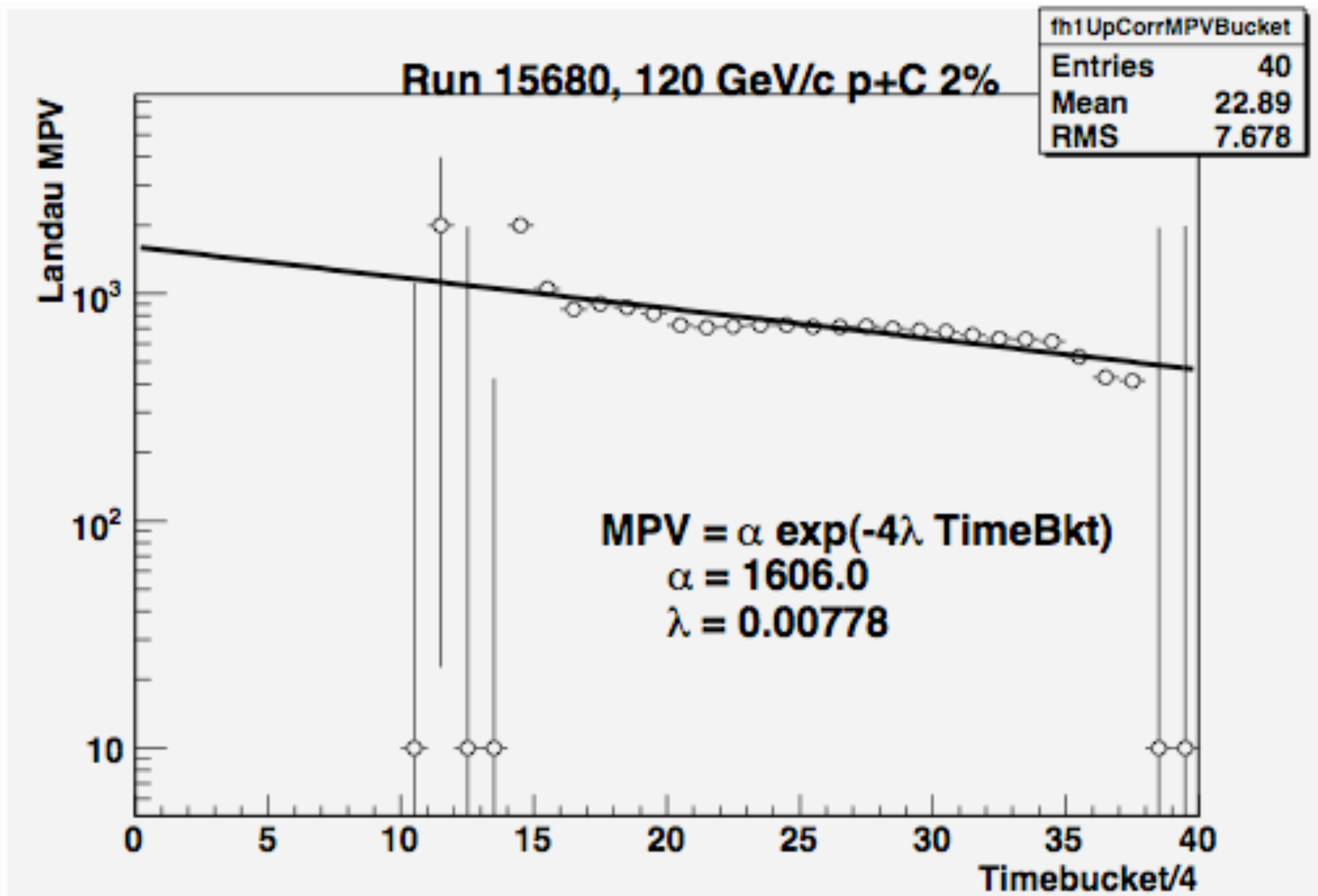

Figure 11: Most probable value (MPV) from Landau fits to dE/dx as a function of drift distance (in units of timebucket/4) in the TPC.

Application of Gain Corrections

Methods to be added to TPCRUtils for use in pass3:

a. Retrieve and hold constants for a given run from DB.

b. Given ADC and padrow of a given digit/cluster, return the anode gain corrected value

c. Given ADC and timebucket of a given digit/cluster, return drift corrected value

At this point we do not have an absolute calibration, just a relative one.

Absolute calibration can to be studied later; will be useful for comparing with Monte Carlo.

Where would we like the mean (in ADC counts) to sit?

Next steps…

- Corrections should be generated during pass2.
- We need to write the root output files for TPCReco in order to be able run both the anode and drift calibrations (they process track cluster information post-run to extract parameters)
- Anode and drift calculation must be done in separate jobs (drift needs anode calibs) but anode calibration could be run in same job as TPCReco.
- After pass2, I will look at results in db to make sure things are reasonable. If there are issues, I should be able to use the histogram output to debug and correct them.
- Calibrations should then be applied to data in pass3, (prior to cluster-finding? hit-fitting?)
- We should investigate the ADC thresholds with the calibrated values and see what the impacts on cluster-finding/fitting are.